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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/006,578	12/06/2001	Manoj K. Jain	TI-31858	4968

23494 7590 03/02/2005

TEXAS INSTRUMENTS INCORPORATED  
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EXAMINER

LE, THAO X

ART UNIT PAPER NUMBER

2814

DATE MAILED: 03/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	Application No.	Applicant(s)	
	10/006,578	JAIN, MANOJ K.	
	Examiner	Art Unit	
	Thao X. Le	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 01/31/05.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1,4-9 and 11-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,4-9 and 11-16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)     | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date. _____  | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

1. Claims 2-3, 10 are canceled in the amendment dated 18 Aug. 2004

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 4-9, 11-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6291340 to Sandhu et al. in view of US 6693030 to Subrahmanyam et al.

Regarding to claims 1, 4, Sandhu discloses a method of forming a conductive structure in an integrated circuit in Fig. 1, comprising the steps of: forming a dielectric layer 32, column 6 line 57, over a semiconductor body, forming a hole 31, column 6 line 65, fig. 3, in dielectric layer 32, forming a conductive liner 35, column 7 line 1, in hole 31, annealing conductive liner, column 7 lines 16-22, forming a conductive barrier 41, column 7 line 13, fig. 4, filling hole 131 with a conductive material 62, column 7 line 30.

But, Sandhu does not expressly disclose after annealing conductive liner, treating conductive liner with plasma hydrogen to reduce a native oxide that form on conductive liner.

However, Subrahamanyan reference discloses a method wherein the conductive titanium or TiN, column 8 line 22, is being treated with plasma comprises hydrogen, column 8 line 24, to reduce a native oxide that form on conductive film, column 3 lines 34-36 and column 7 lines 1-5. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the method of treating titanium film with hydrogen plasma of Subrahamanyan to treat the conductive film 35 of Sandhu, because such hydrogen plasma treatment would have remove the oxide and contaminant on the surface of the conductive layer and to improve the electro migration resistance as taught by Subrahamanyan, column 3 lines 1-15 and 50-54. Also, McDeVitt is disclosing such improvement for titanium layer having similar two step annealing process in column 7 lines 1-20.

Regarding to claims 5-7, 12-15, Sandhu does not disclose the method wherein the hydrogen containing atmosphere comprises pure hydrogen or hydrogen mixed with a carrier gas.

But, Subrahamanyan reference discloses the method where the hydrogen containing atmosphere comprises pure hydrogen or hydrogen mixed with a carrier gas or ammonia, column 7 line 58. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the method of treating titanium film with hydrogen plasma of Subrahamanyan to treat the conductive film 35 of Sandhu, because such hydrogen plasma treatment would have remove the oxide and contaminant on the surface of the conductive layer

and to improve the electro migration resistance as taught by Subrahmanyam, column 3 lines 1-15 and 50-54.

With respect to ammonia, the mixture of hydrogen and nitrogen gas would react and result in ammonia gas.

Regarding claims 8, 16, 11 Sandhu does not disclose the method further comprising the step of repeating treating step prior to filling step.

But Subrahmanyam reference discloses the method as discuss in the above claim 1 can be done before or after deposition of the barrier layer, column 3 line 51-52, prior to filling step, column 8 line 7. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the method of treating titanium film with hydrogen plasma of Subrahmanyam to treat the barrier film 41 of Sandhu, because such hydrogen plasma treatment would have remove the oxide and contaminant on the surface of the conductive layer and to improve the electro migration resistance as taught by Subrahmanyam, column 3 lines 1-15 and 50-54.

Regarding to claim 9, Sandhu discloses a method for forming a contact in an integrated circuit, comprising the steps of: forming a dielectric layer 32, column 6 line 57, over a semiconductor body, etching a contact hole 31, column 6 line 65, fig. 3, extending through dielectric layer 32, deposited titanium 35, column 7 line 1, in hole 31, over dielectric layer, including on exposed surface with contact hole, annealing titanium, column 7 lines 16-22, deposit TiN 41, column 7 line 13, fig. 4, over titanium, and then filling contact hole 131 with a tungsten 62, column 7 line 30.

But Sandhu does not expressly disclose the method comprising treating titanium with hydrogen prior to annealing step to reduce a native oxide that form on titanium.

However, Subrahmanyam reference discloses a method wherein the conductive titanium or TiN, column 8 line 22, is being treated with plasma comprises hydrogen, column 8 line 24, to reduce a native oxide that form on conductive film, column 3 lines 34-36 and column 7 lines 1-5. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the method of treating titanium film with hydrogen plasma of Subrahmanyam to treat the conductive film 35 of Sandhu, because such hydrogen plasma treatment would have remove the oxide and contaminant on the surface of the conductive layer and to improve the electro migration resistance as taught by Subrahmanyam, column 3 lines 1-15 and 50-54. Also, McDevitt is disclosing such improvement for titanium layer having similar two step annealing process in column 7 lines 1-20.

### ***Response to Arguments***

4. Applicant's arguments filed on 31 Jan. 2005 have been considered but are moot in view of the new ground(s) of rejection.

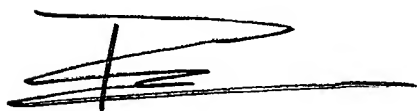
### ***Conclusion***

Art Unit: 2814

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to be 'Thao X. Le', with a stylized, sweeping underline.

Thao X. Le  
23 Feb. 2005